CANUSA/U.S. Spruce Budworms Program - West

Final Report

Title: Field comparison of two baculovirus preparations for control of western spruce budworm when applied with ground spray equipment.

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Field Comparison of Two Baculovirus Preparations for Control of Western Spruce Budworm When Applied With Ground Spray Equipment: A Final Report

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Introduction

Diseases of insects caused by baculovirus infection play an important role in the population dynamics of several important forest defoliators. The occurrence of natural epizootics have been recorded during outbreaks of tent caterpillars (Malacosoma), tussock moths (Orgyia, Lymantria), and sawflies (Gilpinia, Neodiprion) (Stairs 1971).

Spruce budworm, Choristoneura fumiferana, and western spruce budworm C. occidentalis, are cross-infected by nucleopolyhedrosis and granulosis viruses (Cunningham et al. 1983). However, there are no reports of natural epizootics having occurred in populations of these two destructive defoliators of coniferous forests in North America. Aerial spray trials to introduce virus for control of budworm in Canada have been conducted annually since 1971 (Cunningham 1980). Larval mortality rates ranged from 30 percent to over 90 percent, with the virus treatments generally providing negligible foliage protection.

This study was undertaken to evaluate the potential of two baculoviruses, a nucleopolyhedrosis virus (NPV), and a granulosis virus (GV) for control of western spruce budworm when applied with ground spray equipment. The trial was designed to determine the effect of variations in application timing and virus dose levels on control.

Materials and Methods

The study was conducted in a second-growth stand of grand fir, Abies grandis, on the Umatilla National Forest 30 miles SE of Heppner, Oregon in 1981. A total of 40 trees from 15 to 45 feet tall was selected for treatment. The experimental design was a 2x3x2 factorial plus an untreated control, with the two virus types (NPV vs. GV) applied at three dosage levels over two application timings (June 19 vs. July 1). Two trees were assigned at random to each of the 12 treatment groups, with the remaining 16 trees left as untreated controls. The trees were scattered over an area of approximately 2 ha to avoid contamination between trees by drift during spraying.

Both virus types were propagated in WSB at the FSL, Corvallis, in 1980 by D. M. Scott. Crude virus stocks were prepared by blending diseased larval cadavers in an equal volume of TRIS buffer in a Waring blender at high speed for 4 minutes. In blending, the temperature of the mixtures never exceeded 17° C. Haemocytometer counts showed that the NPV stock contained 2.18×10^9 polyhedral inclusion bodies (PIB's) per ml. No count of capsules in the GV stock were made; however, the two virus stocks contained equal proportions of diseased larval tissue per unit volume.

The highest virus dosage was prepared by adding 100 ml of virus stock per 20 gal. of water. The medium and low dosage treatment contained 50 and 25 ml of the crude virus stocks per 20 gal., respectively. All tank mixes contained animal feed-grade molasses (5% v/v). At these dilutions the low, medium, and high dose levels of the NPV contained 7.2×10^5, 1.4×10^6, and

2.9×10^6 PIB/ml, respectively. A truck-mounted Bean model 1010 hydraulic sprayer was used to apply the treatments to the point of spray runoff.

Larval development was 50 percent second- and 50 percent third-instar at the time of the early application on June 19. Development at the late application timing on July 1 was 10 percent second-, 53 percent third-, and 37 percent fourth-instar.

Budworm larval densities were based on a count of the number of current shoots and budworm larvae on seven 45-cm branch samples taken 2 days before spraying, and on July 21 when the surviving larvae were beginning to pupate. Defoliation estimates were recorded on a sample of 25 current shoots per branch, 4 branches/tree, collected at the time of the postspray population measurement on July 21.

Population data were subjected to an analysis of variance with single degree of freedom contrasts used to test control vs. factorial, NPV vs. GV, dosage levels, and the virus x dosage interaction at the 0.05 level.

Results and Discussion

Results of the population density measurements are given in Table 1. There were no significant differences in the prespray larval densities. Analysis of the postspray density data collected on July 21 showed the control vs. factorial contrast was significantly different for both application timings. Significant differences were not detected for virus type, dose levels, or for the interaction between virus type and dosage. However, an

inspection of the survival ratios indicate the GV treatment provided better budworm control when applied at the early timing (June 19) than at the late timing (July 1), and probably reflects the longer incubation period of the GV virus.

Defoliation estimates showed both virus treatments, average over all three dosage levels, provided 20-50 percent foliage protection (Table 2).

Ground applications of NPV and GV virus preparations resulted in significant reductions in western spruce budworm populations and in some foliage protection. Under our test conditions we were not able to show a significant response to three dose levels representing a fourfold increase from the lowest to the highest tank mix concentration.

Survival rates exceeded 10 percent at the initiation of pupation, and are probably higher than would be considered necessary for successful population control. While an increase in dosage would probably alleviate this problem, cost factors would become significant. Also, these baculovirus preparations are not available for extensive application. In contrast to baculoviruses, commercial formulations containing the bacterium, Bacillus thuringiensis, have been shown to provide excellent budworm control at economical costs when applied with ground-operated spray equipment (Stelzer 1980).

Table 1. Effects of NPV and GV virus treatments on larval populations of western spruce budworm. Heppner, OR. 1981.

Treatment	Application Timing	Number of budworm larvae/100 buds — Dose Level 1/ Low	Medium	High	Check
		--Prespray Sample (6/18, 6/30)--			
NPV	Early (6/19)	30.6	43.4	32.0	23.8
	Late (7/1)	18.6	27.0	30.8	20.7
GV	Early (6/19)	34.9	27.8	24.2	32.0
	Late (7/1)	27.2	18.2	31.4	33.7
		--Postspray Sample (7/21)--			
NPV	Early (6/19)	3.1 (.10) 2/	3.2 (.07)	3.0 (.09)	7.8 (.33)
	Late (7/1)	1.7 (.09)	2.0 (.07)	2.8 (.09)	9.9 (.48)
GV	Early (6/19)	4.5 (.13)	3.3 (.12)	2.8 (.12)	8.9 (.28)
	Late (7/1)	6.3 (.23)	1.3 (.07)	5.5 (.18)	14.9 (.44)

1/ The low, medium, and high dosage levels contained 0.625, 1.25, and 2.5 g infected larval tissue per gallon of carrier, respectively. The NPV treatment continued 7.2×10^5, 1.4×10^6, and 2.9×10^6 PIB per ml of carrier. GV capsules were not counted.

2/ Values in brackets represent survival ratio (postspray density/prespray density).

Table 2. Defoliation of grand fir by western spruce budworm following ground application of two baculovirus preparations. Heppner, OR. 1981.

Treatment[1/]	% Defoliation (SE)	
	Early timing (6/19/80)	Late timing (7/1/80)
NPV	69.1 (6.6)	41.1 (8.2)
GV	44.8 (6.1)	42.6 (7.3)
Check	90.4 (8.3)	90.4 (8.3)

1/ Treatment averages over three dose levels; two trees/dose level.

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